

REMARKS

Claims 6 and 7 are presently pending in the application.

Claim 6 has been amended to incorporate the subject matter from claims 1 and 3, now canceled. Additionally, claims 2, 4, and 5 have been canceled without prejudice. No new matter has been added by these amendments, and entry is respectfully requested.

The Presently Claimed Invention

The presently claimed invention relates to a urethane prepolymer obtained via reaction of a specific crystalline polyester polyol and a polyisocyanate and a hot-melt adhesive which contains the prepolymer. The crystalline polyester polyol has a melting point of 90 to 120°C and is the polycondensation reaction product of a dicarboxylic acid component comprising 85 to 99 mol % of an aromatic dicarboxylic acid and 15 to 1 mol % of a specific aliphatic dicarboxylic acid having the formula $\text{HOOC}-(\text{CH}_2)_n-\text{COOH}$ ($n = 8$ to 10) with an aliphatic diol component having the formula $\text{HO}-(\text{CH}_2)_m-\text{OH}$ ($m = 11$ to 20). Applicants have determined that the ratio of aliphatic dicarboxylic acid to aromatic dicarboxylic acid is critical for providing the desired properties of the polyol and resulting prepolymer: when the amount of aromatic dicarboxylic acid is less than 85 mol %, the balance between surface hardness and setting time becomes insufficient. Further, if the aromatic dicarboxylic acid is used alone, there is poor efficiency of working the material.

Applicants have determined that crystalline polyether polyols having melting points lower than 90°C or higher than 120° C lead to urethane prepolymers which exhibit slower setting time, poor thermal resistance, and/or a decrease in efficiency of working during production. It is also preferred that the crystalline polyols have enthalpies of crystallization using DSC of 55 J/g or more. Lower enthalpies have been found to remarkably decrease crystallinity, retard setting time, and/or decrease surface hardness. Since melting point and enthalpy of crystallization are determined by the structure of the polyol, the ratio of aromatic to aliphatic dicarboxylic acids is critical for providing the polyester polyol and the resulting urethane prepolymer and hot-melt adhesive produced therewith with the desired properties.

The criticality of the claimed ratio and the optimum ratio of aromatic dicarboxylic acid to aliphatic dicarboxylic acid in the polyester polyol have been previously demonstrated on the record. Additionally, the specific dicarboxylic acids which are utilized are also important for

providing the desired properties. As demonstrated in the examples and comparative examples and summarized in paragraph [0036], when adipic acid is used as the aliphatic dicarboxylic acid, setting time of the urethane prepolymer is prolonged, which is undesirable. In order to avoid such problems, the specification teaches that the aliphatic acid may be sebacic or dodecanedioic acid (paragraph [0012]), for example, with dodecanedioic acid being preferred.

Prior Art Rejections

In the Office Action, the Examiner has rejected claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over EP 1,149,850 ("EP '850") in view of U.S. Patent No. 4,975,477 of Cox et al. ("Cox"). The Examiner has also rejected claims 1-7 under 35 U.S.C. §103(a) as being unpatentable over EP '850 in view of JP 62-043451 ("JP '451"). Further, claims 1-7 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application Publication No. 2003/0144454 of Krebs et al. ("Krebs") in view of EP '850 and Cox. Finally, the Examiner has rejected claims 1-7 under 35 U.S.C. §103(a) as being unpatentable over Krebs in view of EP '850 and JP '451. It is noted that in several of the rejections, the Examiner refers to claims 1-8, but there were only 7 claims pending in the application at the time of the Office Action. Accordingly, these rejections have been interpreted as referring to claims 1-7. Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

Rejection Under § 103(a) Based on EP '850 in view of Cox

Regarding claims 1-7, the Examiner argues that EP '850 teaches a polyester polyol that is the reaction product of diol and dicarboxylic acid, having a molecular weight of 1500 to 15,000. The dicarboxylic acid allegedly comprises both aromatic and aliphatic compounds, specifically terephthalic acid and dodecanedioic acid, and the diol consists of dodecane diol. It is allegedly taught that the polyester polyol is then reacted with polyisocyanate, thereby forming a polyurethane prepolymer, which is useful as a hot-melt adhesive and may further comprise plasticizer, tackifier, and antioxidants. EP '850 allegedly also teaches that the hot-melt adhesive can bond substrates such as wood and metal. The Examiner acknowledges that EP '850 does not teach how much aromatic dicarboxylic acid is included in the polyester polyol.

However, the Examiner argues that Cox also teaches hot-melt adhesives containing polyester polyol, which is the reaction product of dicarboxylic acid and diol. The acid allegedly consists of both aromatic and aliphatic compounds, such as terephthalic acid and C₁₂ aliphatic acid, as well as C₁₂ diol. The hot-melt adhesive allegedly comprises plasticizers and tackifying resins and is useful in bonding wooden substrates. The aromatic and aliphatic acids are allegedly present in amounts ranging from (70-100):(0-30) mol%, and Cox allegedly teaches that this formulation results in a polyester that has desirable flow properties without sacrificing bond strength.

Accordingly, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the amounts of aliphatic and aromatic dicarboxylic acids in EP '850 based on the formulation of Cox since the references teach analogous compositions that are directed toward polyester based hot-melt adhesives that bond the same substrates, and the specific amounts of aromatic and aliphatic acid contribute to improved processibility without the loss of mechanical properties. Regarding claims 3 and 4, the Examiner takes the position that the prior art polyester would obviously exhibit the claimed properties based on identical reactants and amounts as claimed. Applicants respectfully traverse this rejection as follows.

EP '850 teaches a crystalline polyester polyol prepared from a polybasic carboxylic acid component and an aliphatic hydrocarbon diol component. In paragraph [0016], EP '850 teaches that "the polybasic carboxylic acid component to be used in the invention includes an aliphatic dicarboxylic acid and an aromatic dicarboxylic acid." However, while EP '850 provides specific details regarding the aliphatic dicarboxylic acid, including the number of carbon atoms and a list of concrete examples, no details are provided regarding the *aromatic* dicarboxylic acid. Further, all 54 of the Examples of EP '850 utilize one or more aliphatic dicarboxylic acids as the polybasic carboxylic acid component, and no aromatic dicarboxylic acid is ever included. Therefore, EP '850 is not enabled with respect to the aromatic dicarboxylic acid.

The Examiner argues that it would have been obvious to utilize the amounts of aromatic and aliphatic dicarboxylic acids taught by Cox in the polyol of EP '850. However, this combination would result in a polyol containing 0-40% aliphatic dicarboxylic acid (Cox col. 2, line 4). Preferred embodiments of Cox include 20-40% aliphatic dicarboxylic acid (col. 3, lines 66-67) and 25% aliphatic dicarboxylic acid (col. 4, lines 6-7). Cox does not teach or suggest an

amount of 1-15% as claimed. That is, while Cox teaches the genus of 0-40%, Cox does not teach the species of 1-15%. The species is not rendered obvious by the genus because there would have been no teaching, suggestion, or motivation based on Cox to utilize the specifically claimed species. In fact, the preferred embodiments of Cox (20-40% and 25%) are in the middle to the upper end of the 0-40% range of Cox. Therefore, one skilled in the art selecting a species from the genus of Cox would select a narrow range in the *middle to upper end* of the 0-40% range, and there would have been no motivation to select the claimed range of 1-15%, at the *bottom* of the Cox range.

As demonstrated in Comparative Example 13 of the present application, when the proportion of aliphatic dicarboxylic acid exceeds 15 mol% and becomes 20 mol %, the viscosity increases and the enthalpy in crystallization decreases. Accordingly, the crystallinity remarkably decreases, causing retardation of setting time and decrease in surface hardness (see WO 2005/044891 p. 4, lines 19-20). The criticality of the claimed range has thus been demonstrated. Since Cox did not recognize the disadvantages of utilizing greater proportions of aliphatic dicarboxylic acid, the results exhibited by the presently claimed materials would not have been expected based on the proposed combination of WO '850 and Cox.

Finally, the polyester resin of Cox has a molecular weight so high that it can be used as an adhesive as is, and also has a high melting point. Cox also teaches that a polyester mixture containing a plasticizer has a melt viscosity of 10,000 to 50,000 cP. If the polyester resin as described in Cox or EP '850 were to be used as the polyester polyol in the same manner as the presently claimed polyol, each component would need to be reacted at a temperature not lower than the melting point of the polyester resin. However, isocyanate reacts with a urethane bond at 130°C or higher to form an allophanate bond and a cross-linkage. Accordingly, urethane prepolymers and hot melt adhesives cannot be produced at high temperatures. Therefore, there would have been no motivation to use the polyester resin as described in EP '850 or Cox as a raw material for forming urethane. The polyester resins of the prior art are designed to provide satisfactory performance. Therefore, one skilled in the art would have no motivation to react such polyester resins with isocyanates to further increase the molecular weight thereof.

For at least these reasons, reconsideration and withdrawal of the § 103(a) rejection based on EP '850 in view of Cox are respectfully requested.

Rejection Under §103(a) Based on EP '850 in view of JP '451

Regarding claims 1-7, the Examiner acknowledges that EP '850 does not teach the amounts of aromatic and aliphatic acids. However, the Examiner argues that JP '451 also teaches hot-melt adhesives comprising polyester polyol, wherein the polyol is the reaction product of C₁₂ diol and dicarboxylic acid, specifically aromatic and C₁₂ aliphatic acid. In particular, JP '451 allegedly teaches that the aromatic and aliphatic acids are present in amounts of from (90-100):(0-10) mol % respectively. The Examiner takes the position that this results in adhesives that exhibit improved heat resistance without sacrificing adhesion strength, and therefore concludes that it would have been obvious to one having ordinary skill in the art to utilize the same amounts of aliphatic and aromatic dicarboxylic acid as disclosed by JP '451 in EP '850 in order to obtain an adhesive that exhibits the same improved performance properties. Regarding claims 3 and 4, the Examiner argues that one skilled in the art would expect the prior art polyester to exhibit the claimed properties since it has the same reactants and amounts as claimed. Applicants respectfully traverse this rejection as follows.

As previously explained, EP '850 is not enabled with respect to an aromatic dicarboxylic acid, and thus there would have been no motivation based on EP '850 to utilize an aromatic dicarboxylic acid as claimed.

Additionally, there would be no reasonable expectation of success based on the proposed combination of EP '850 and JP '451. JP '451 teaches a polyester resin having a high glass transition point and softening point and excellent adhesive strength and solubility. Such a polyester resin is obtained by combining two specific kinds of polyesters. It is apparent from considering Comparative Examples 1 and 3 of JP '451 that the desired properties are not attainable when only one polyester is included in the resin. Accordingly, there would have been no motivation for one skilled in the art to apply the relative amounts of the components in the polyester resin of JP '451, appropriate for a resin containing two different kinds of polyesters, to a single type polyester, as taught by EP '850, and no reasonable expectation of success in such a combination. Accordingly, reconsideration and withdrawal of the §103(a) rejection based on EP '850 in view of JP '451 are respectfully requested.

Rejection Under § 103(a) Based on Krebs in view of EP '850 and Cox

Regarding claims 1-7, the Examiner argues that Krebs teaches a polyurethane hot-melt adhesive based on the reaction product of a polyester polyol and polyisocyanate, wherein the polyester has an average molecular weight as high as 10,000 and is based on aliphatic diol and a mixture of aromatic and aliphatic dicarboxylic acid. In particular, Krebs allegedly teaches that the aliphatic dicarboxylic acid and diol consist of dodecanedioic acid and dodecanediol, respectively. The Examiner acknowledges that Krebs does not teach or suggest the amounts of the respective species that comprise the dicarboxylic acid mixture. However, as previously explained, EP '850 allegedly teaches hot-melt adhesives based on polyester polyols comprising the reaction product of terephthalic acid, dodecanedioic acid, and dodecanediol. In particular, it is allegedly taught that these reactants are preferred because they result in hot-melt adhesives that exhibit sufficient bond strength while maintaining rapid set time. Therefore, the Examiner takes the position that it would have been obvious to limit the reactants of Krebs to the relevant species of EP '850 based on the motivation that it facilitates application of the adhesive without losing mechanical strength.

Furthermore, as previously discussed, Cox allegedly teaches a polyester based hot-melt adhesive that is produced by reacting relevant compounds in amounts that satisfy the present claims, and further explains that the resulting adhesive has desirable flow properties without the sacrifice of bond strength. Therefore, the Examiner concludes that it would have been obvious to adjust the amounts of aliphatic and aromatic dicarboxylic acid in Krebs based on the formulation of Cox since Krebs and Cox teach analogous reactants directed towards polyester based hot-melt adhesives useful in bonding the same materials, and the specific amounts of aromatic and aliphatic acid contribute to improved processibility in adhesives without loss of mechanical performance. Regarding claims 3 and 4, the Examiner argues that one skilled in the art would expect the prior art polyester to exhibit the claimed properties since it has the same reactants and amounts as claimed. Applicants respectfully traverse this rejection as follows.

As acknowledged by the Examiner, Krebs fails to teach the relevant reactants with sufficient specificity, and also fails to teach the ratio of aliphatic and aromatic dicarboxylic acids. That is, Krebs teaches a hot melt composition containing, as essential components (a) a reaction product of a polyester polyether polyol with an isocyanate and (b) a reaction product of a polyester polyol with an isocyanate. Krebs is silent as to the co-presence of an aromatic

dicarboxylic acid and an aliphatic dicarboxylic acid in one urethane compound. In fact, although a polyester prepared from terephthalic acid and isophthalic acid as dicarboxylic acid components is described in Example 2 of Krebs, such a polyester is obtained from only aromatic dicarboxylic acids as dicarboxylic acid components, and is a *non-crystalline* polyester polyol. Accordingly, Krebs does not teach or suggest a crystalline polyester polyol prepared from aliphatic and aromatic dicarboxylic acids as claimed.

Further, even if there would have been a motivation to combine Krebs with EP '850 and Cox, as previously explained, EP '850 is not enabled with respect to the aromatic dicarboxylic acid. The presently claimed amount of aliphatic dicarboxylic acid would also not have been obvious based on the broad teaching of Cox. Accordingly, even the proposed combination of Krebs, EP '850, and Cox, if proper, would not teach or suggest all of the claimed elements, and reconsideration and withdrawal of the § 103(a) rejection are respectfully requested.

Rejection Under §103(a) Based on Krebs in view of EP '850 and JP '451

Finally, regarding claims 1-7, the Examiner argues that Krebs teaches polyurethane hot-melt adhesive based on polyester polyol and polyisocyanate, in which the polyester is produced by the reaction of dodecanedioic acid, terephthalic acid, and dodecanediol. The Examiner again acknowledges that Krebs does not teach these reactants with sufficient specificity, and that no ratio of aliphatic and aromatic dicarboxylic acid is listed. However, the Examiner argues that EP '850 teaches hot-melt adhesives based on polyester polyols comprising the reaction product of terephthalic acid, dodecanedioic acid, and dodecanediol. Therefore, the Examiner concludes that it would have been obvious to limit the reactants of Krebs to the relevant species of EP '850 to facilitate application of the adhesive without losing mechanical strength.

Additionally, JP '451 allegedly teaches polyester based hot-melt adhesives that contain reactants in amounts as claimed, and further teaches that such ranges result in adhesives having desirable flow properties without sacrificing any bonding strength. Therefore, the Examiner concludes that it would have been obvious to adjust the amounts of aliphatic and aromatic dicarboxylic acids in Krebs based on the formation of JP '451 since Krebs and JP '451 teach analogous reactants directed toward polyester based hot-melt adhesives useful in bonding wooden substrates, and the specific amounts of aromatic and aliphatic acid contribute to improved processibility without loss of mechanical performance. Regarding claims 3 and 4, the

Examiner argues that one skilled in the art would expect the prior art polyester to exhibit the claimed properties since it has the same reactants and amounts as claimed. Applicants respectfully traverse this rejection as follows.

As previously explained, Krebs does not teach or suggest a crystalline polyester polyol which is prepared from specific aliphatic and aromatic dicarboxylic acids, and EP '850 is not enabled with respect to aromatic dicarboxylic acids. Additionally, there would have been no motivation for one skilled in the art to apply the relative amounts of the components in the polyester resin of JP '451, appropriate for a resin containing two different kinds of polyesters, to a single type polyester, as taught by EP '850, and no reasonable expectation of success in such a combination. Therefore, even the proposed combination of references, if proper, would not teach or suggest all of the claimed elements. Reconsideration and withdrawal of the §103(a) rejection based on Krebs in view of EP '850 and JP '451 are respectfully requested.

In view of the preceding Amendments and Remarks, Applicants respectfully submit that the pending claims are patentably distinct from the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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